

DOCUMENT RESUME

ED 173 078

SE 027 815

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TITLE The Coastal Zone: Man and Nature. An Application of the Socio-Scientific Reasoning Model.
PUB DATE Mar 79
NOTE 17p.; Paper presented at the annual meeting of the National Association for Research in Science Teaching (52nd, Atlanta, Georgia, March 21-23, 1979); Contains occasional light and broken type; Best copy available
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Curriculum Development; Curriculum Evaluation; Decision Making; Educational Research; *Environmental Education; Models; *Petroleum Industry; Pollution; Science Education; *Simulation; *Water Pollution Control
IDENTIFIERS Research Reports

ABSTRACT

The curriculum model described here has been designed by incorporating the socio-scientific reasoning model with a simulation design in an attempt to have students investigate the onshore impacts of Outer Continental Shelf (OCS) gas and oil development. The socio-scientific reasoning model incorporates a logical/physical reasoning component as defined by the Kohlbergian paradigm and a decision-making strategy based on the work of Dewey. The curriculum utilizes role playing, simulations, trend analysis, dilemma discussions, scenario writing, hypothesis generation and testing, problem solving, variable manipulation, and model building. An evaluation for the curriculum is described. Incorporated are tests of social/moral reasoning skills, critical thinking skills, and logical and physical reasoning skills. (89)

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THE COASTAL ZONE: MAN AND NATURE
AN APPLICATION OF THE SOCIO-SCIENTIFIC REASONING MODEL

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SE 027 815

The coast, that bright thin edge of the continent where you can sit with your back to the crowds and gaze into seemingly infinite space, is now a theatre of discovery. On the seashore where terrestrial life began, we have to use all the wits man has developed to figure out how life can continue, how to design our complex, fast-moving, energy-consuming existence without destroying nature's system of life support in the process. Wherever it leads neither man nor coast will be the same again.

The Thin Edge: Man and Coast Crisis

Introduction

Man has a universal yearning for the coast, its smooth beaches, its picturesque horizon - shimmering sands, seagulls, sea-worn pebbles, and minute swimming sea animals. The coastal region has also been one of the most productive of the earth's ecosystems. Its trees, its fish, its resources, its soil and its climate have provided the ideal environment to meet man's needs for survival. It is no wonder that 53 percent of the United State's population and 90 percent of its population growth are on the coastal zone. In 1940 only 29.8 million people lived within fifty miles of this narrow strip. In 1970 the coastal population had increased to 48 million people, almost a quarter of all Americans, and it has been projected that by the year 2000, two hundred million Americans

will occupy this thin edge of land. The coastal zone of the United States is currently under enormous pressure created by increasing population, industrialization and technology. Many environmental problems and issues have developed as a result of these pressures.

Many of the issues and problems involving the coastal zone environment are currently being identified. Solutions are being sought. The issues include mining natural resources such as gas and oil, thermal pollution from nuclear power plants, waste disposal in the estuaries and the sea, the need for the beach as a barrier against disaster, the visual value of the coastal zone, among others. These issues are broad in scope in that their solutions will require the efforts of a variety of individuals and institutions including federal, state and local government, universities, industries, and citizens groups. However, each of these groups often have very different and sometimes limited perspectives related to their particular set of values or ethical viewpoint on the issue. If we are to develop the best solutions for these issues or problems we must develop an environmentally ethical citizenry with a broader conceptual view of the world we live in, and a greater understanding of the interdependence of all living things.

Numerous coastal and environmental problems and issues confronting our modern world are, in essence, conflicts that interface science, technology, and society. In order to

formulate solutions to these problems, many decisions have to be made which not only necessitate the application of science and technology but also require the formulation of value judgements. In order to participate fully in these decision-making processes individuals should have the opportunity to develop their ethical reasoning skills, decision-making skills, critical reasoning skills, and social interaction skills. Such opportunities and experiences will foster the development of a citizenry capable of resolving the present and the future social and technological dilemmas. The course, Man and Nature: Impacts of Offshore Oil Development on Coastal Environments, has been designed to provide each of the above experiences and opportunities.

Curriculum Model

This curriculum has been designed by incorporating the socio-scientific reasoning model with a simulation design in an attempt to have students investigate the onshore impacts of Outer Continental Shelf (OCS) gas and oil development, a current environmental issue of vital interest to our nation. Although this curriculum addresses the impacts of OCS gas and oil development, the methods, skills, and concepts developed are equally applicable to a variety of environmental issues involving the relationship of population, pollution, resource allocation and depletion, conservation, technology, and urban and rural planning of the total human environment.

The format chosen for this curriculum to provide the students with a variety of more appropriate and meaningful inter/multi-disciplinary experiences is the "simulation game." As part of this simulation the students actually participate in the decision-making process involved in accepting or rejecting the proposed facilities as well as determining the appropriate location for the facilities. The "simulation" format provides the opportunity to inquire into both the specific and general environmental, social, and economic issues and implications of the OCS gas and oil development issue.

The curriculum model which resulted has been termed a socio-scientific simulation. It has been based on the socio-scientific reasoning model as a theoretical base for the curriculum activities and materials. It incorporates the concept of providing a more moral or social atmosphere in order to stimulate the development of ethical or moral reasoning. These three components, the issue, the socio-scientific reasoning model, and the moral or social atmosphere created by the simulation interact to form the basis of the socio-scientific simulation (Figure 1). The interaction of these three components led to the design of the simulation illustrated in Figure 2.

THE SOCIO-SCIENTIFIC SIMULATION

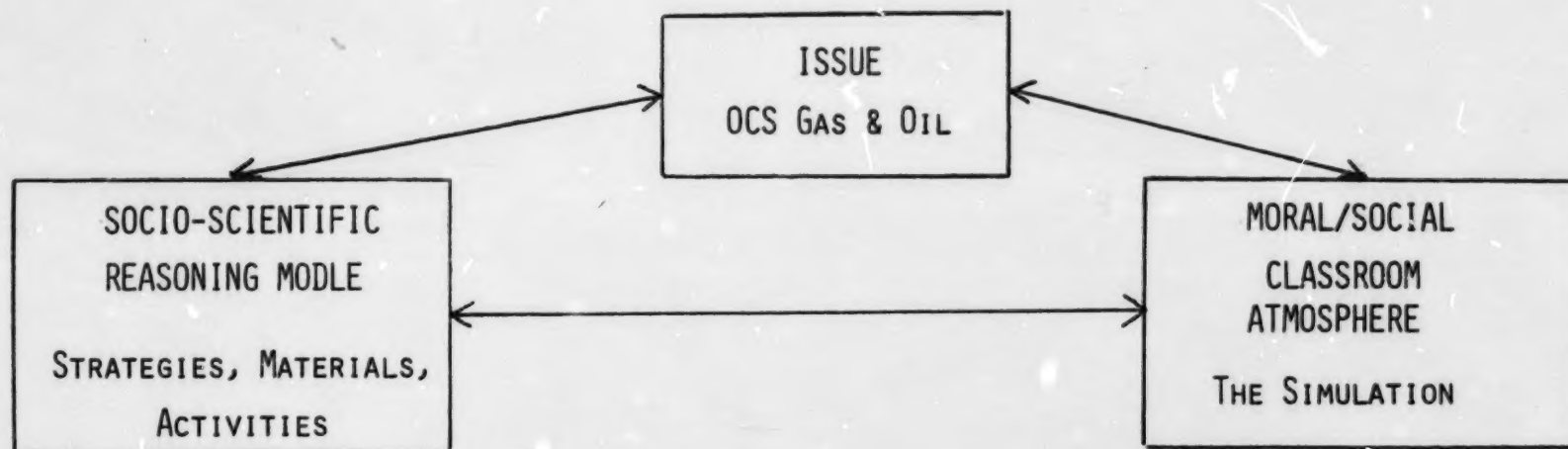
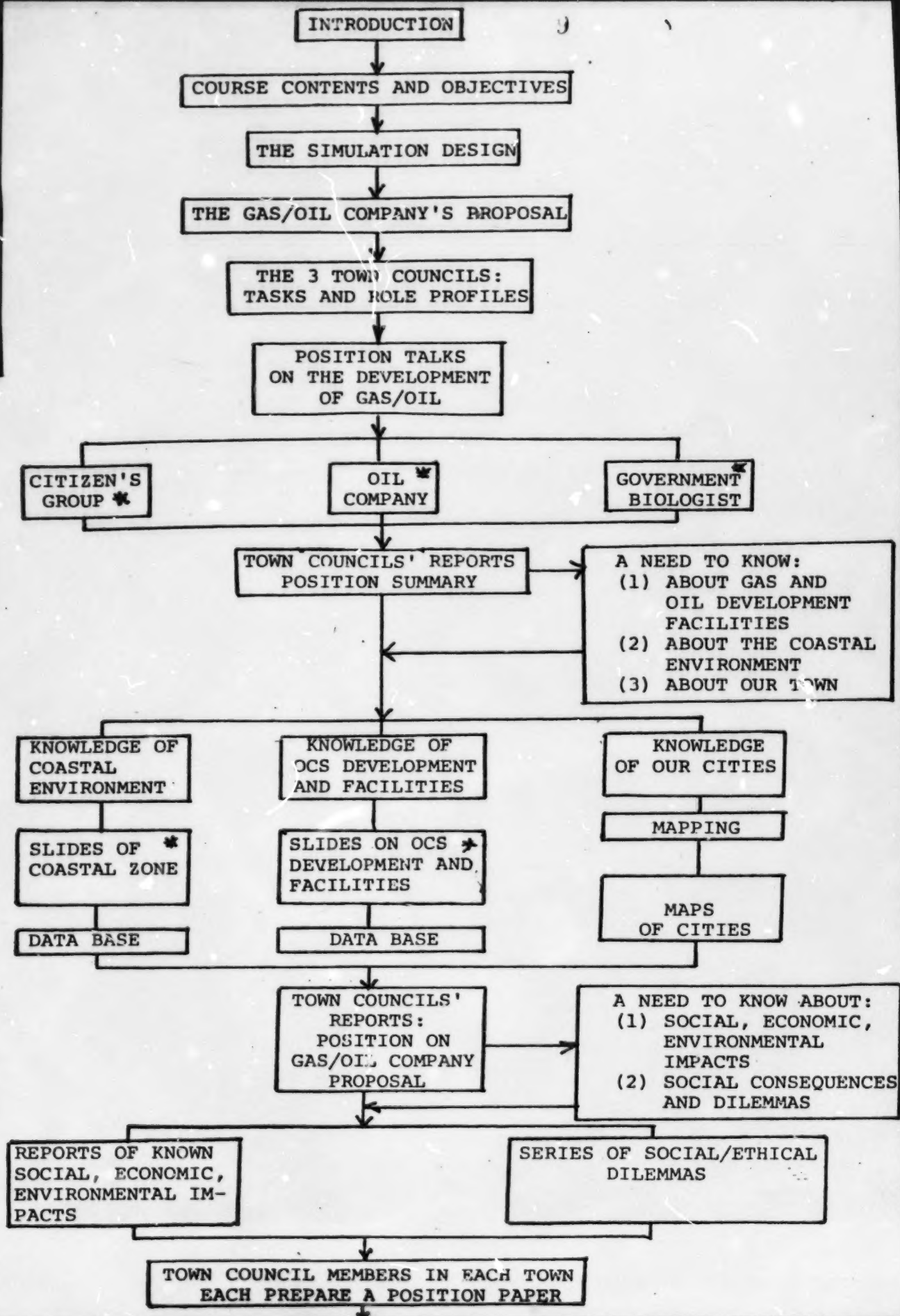


FIGURE 1: THE THREE INTERACTING COMPONENTS OF THE SOCIO-SCIENTIFIC SIMULATION



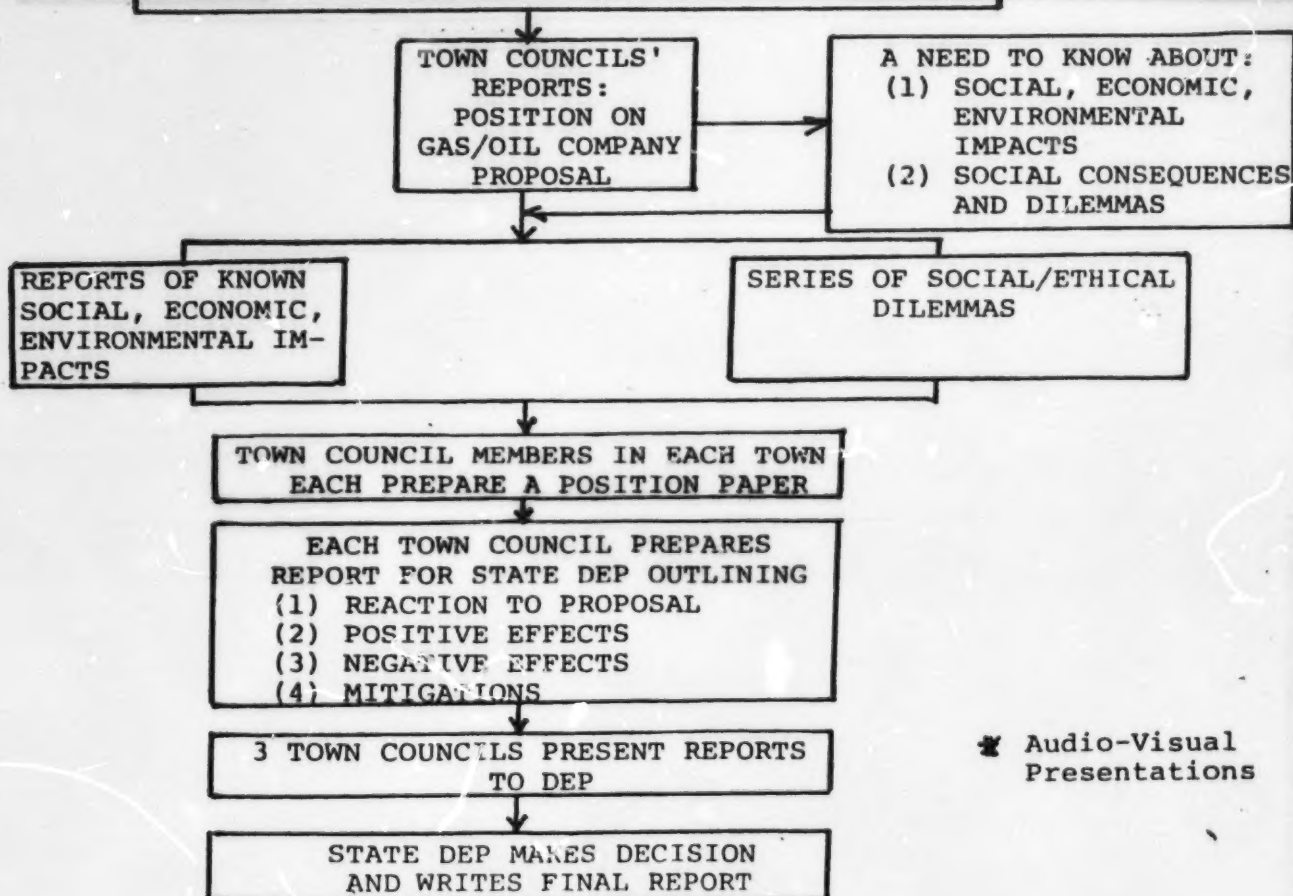


Figure 2. Steps in simulation of onshore impacts of OCS oil and gas development. 10

Experimental Design

This curriculum was designed to stimulate the development of critical moral/ethical reasoning skills as well as to provide the students with the factual/knowledge component of the environmental issues involved. The following skills will be evaluated prior to and after the students experience this curriculum:

1. moral/ethical reasoning,
2. mapping skills,
3. understanding of coastal ecosystem,
4. spatial reasoning.

In order to test for each of these components, the tests used will be the "Environmental Issues Test," "The Coastal Zone: Facts, Processes, and Mapping," and "Spatial Reasoning: Selection from ETS Cognitive-Factors Test." These tests are identified in Table 1. A copy of one of the stories from the Environmental Issues Test is included in the Appendix.

The instruments listed in Table 1 will be administered to the students participating in the pilot program (experimental group) and to a group of matching students serving as a control group. After completing the intervention, both the experimental group and the control group will be compared using a matched-group t-test to determine if the experimental group achieved statistically significant improvement when compared

TABLE 1

INFORMATION ON TEST MEASURES USED TO EVALUATE CURRICULUM INTERVENTION*

INSTRUMENT	PURPOSE	NUMBER AND TYPE OF ITEMS	TIME TO COMPLETE (MINUTES)
ENVIRONMENTAL ISSUES TEST	MEASURES LEVEL OF ETHICAL/MORAL REASONING	5 STORIES, EACH WITH 12 ITEMS, LEIKERT SCALE	35
COASTAL ZONE: FACTS, PROCESSES, MAPPING	MODULE TEST ON FACTUAL/KNOWLEDGE AND MAPPING COMPONENTS	30 ITEMS, MULTIPLE CHOICE	30
SPATIAL REASONING	MEASURE THE COG- NITIVE FACTOR, SPATIAL REASONING	40 ITEMS, MULTIPLE CHOICE	10

*CONTENT VALIDITY WILL BE ESTABLISHED BY A PANEL. RELIABILITY WILL BE ESTABLISHED BY CALCULATING THE SPLIT-HALF RELIABILITY FOR A SET OF TESTS.

with the control group. If the experimental group achieves gains in scores significant at the 0.05 level ($p < 0.05$), the materials will be considered effective in meeting the goals of the project.

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APPENDIX
ELECTRICITY

A large piece of land in the Southwest was bought from an Indian tribe by the Southern Electric Company. The land was bought so that six large coal burning generators could be built. The electricity produced by these stations was to be sent to several large cities in southern California. This land was chosen because it contained great amounts of coal that would be burned to produce power. It was also close enough to California so that power could be transmitted easily and cheaply.

Two generating stations were built. After they were put into operation, a group of young Indians met with the power company and the government. They complained about the great amount of smoke produced by the generators. They said the smoke was blackening the skies and endangering the lives of everyone for hundreds of miles. They were also angered because mining the coal was scarring the landscape and destroying sacred Indian grounds. They said that the older Indian leaders didn't really understand what the land was to be used for when they sold it to the power company. They also felt that they were forced into an unfair agreement. The Indians demanded that the power stations be closed and the land returned.

The power company refused. The company said it was their land and that they could do what they wanted with it. The government said that the sale was legal and that nothing could be done about it. The Indians became desperate and began to make plans to blow up the power station. They felt that this would force the company to close.

Should the Indians blow up the power stations?

- ☐ Yes, they should blow up the stations
- ☐ Can't decide
- ☐ No, they should not blow up the stations

IMPORTANCE

IF YOU WERE ONE OF THE INDIANS, HOW IMPORTANT WOULD EACH OF THESE QUESTIONS BE IN DECIDING WHETHER OR NOT THE POWER STATIONS SHOULD BE BLOWN UP?

Great Imp.	Much Imp.	Some Imp.	Little Imp.	No Imp.	
—	—	—	—	—	1. Whether laws are going to be upheld?
—	—	—	—	—	2. Isn't it only natural for Indians to care so much for their land and their people that they would blow up the power stations?
—	—	—	—	—	3. Are the Indians willing to risk getting shot or going to jail for the chance that blowing up the power stations might help?
—	—	—	—	—	4. Whether the Indians are professional wrestlers, or have considerable influence with professional wrestlers?
—	—	—	—	—	5. Whether the Indians are blowing up the power stations for themselves or doing this solely to help others.
—	—	—	—	—	6. Whether the power company's rights or ownership have to be respected.
—	—	—	—	—	7. Whether the essence of living is more encompassing than the termination of dying, socially and individually.
—	—	—	—	—	8. What values are going to be the basis for governing how people act towards each other.
—	—	—	—	—	9. Whether the power company is going to be allowed to hide behind a worthless law which only protects the rich anyhow.
—	—	—	—	—	10. Whether the law in this case is getting in the way of the most basic claim of any member of society?
—	—	—	—	—	11. Whether the power company deserves to be blown up for being so greedy and cruel?
—	—	—	—	—	12. Would blowing up the power company in such a case bring about more total good for the whole society or not?

From the list of questions above, select the four most important:

Most Important —
 Second Most Important —
 Third Most Important —
 Fourth Most Important —

RESULTS AND BENEFITS

EXPORTABLE CURRICULUM PACKAGE:

ACTIVITY ORIENTED EXPERIENCES
IN THE FORM OF A SIMULATION GAME

ATTITUDE CHANGES IN STUDENTS:

1. ENVIRONMENTAL PLANNING AND CHANGE IS A CONTINUOUS PROCESS
2. THEY CAN PLAY A ROLE IN THIS PROCESS
3. SCIENCE SKILLS AND INFORMATION ARE NEEDED TO MAKE "MORE ADEQUATE" DECISIONS
4. SOCIAL/ETHICAL REASONING IS NEEDED TO MAKE "MORE ADEQUATE" DECISIONS

FINAL OUTCOME:

A SOCIAL-SCIENTIFIC CURRICULUM MODEL

FINAL OUTCOME:

ENVIRONMENTALLY LITERATE AND RESPONSIBLE
CITIZENRY
